INNOVATION TECHNOLOGY OF EARTH REMOTE SENSING

Presented challenges of time-varied space and altitude-varied aircraft-based sensing cover:

- geology (searching mineral deposits such as oil, gas, water on land and sea shelf);
- ecology;
- forestry;
- diagnostics of the oil and gas pipelines.

Final geo-information products is

- 3-D models of the Earth thermal field;
- sections of the geological environment;
- maps of spectral indicators of the landscape systems conditions;
- forecast maps.

Measuring airborne complex based on dirigible:

- thermal imager
- video camera
- ultraviolet camera
- laser scanner
- gas analyzer

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The "Trans-Service" company carries out geophysical services on the basis of aerospace survey in the optical wavelength range, using patented technology of 3-D modeling of the thermal field of the Earth.

The developed technology for survey and processing of thermal information has no parallel in the world and can significantly reduce production and financial costs in the study of geology, mineral prospecting and environmental monitoring of natural and man-made systems.

The method has been successfully tested in Spain, Sweden, Peru and Russia (the Volga-Urals and Western Siberia oil regions, Kamchatka).

The company priority is the implementation and practical application of the dirigibles in the performance of geophysical research, establishment of air monitoring systems based on thermal and gas airships.
The geography of our foreign projects

- Sweden
- Gulf of Cadiz (Spain)
- Gulf of Valencia (Spain)
- Black Sea
- Persian Gulf
- South China Sea (Vietnam)
- Gulf of Mexico (Mexico)
Solved tasks

- Study of the Earth's crust and upper mantle.
- Search for oil and gas deposits both onshore and on sea shelf.
- Search for unloading zones of submarine fresh water and areas of the sea intrusion.
- Search for geothermal heat sources.
- Analysis of the structure of impact craters in the search for hydrocarbons and groundwater.
- Environmental monitoring of natural and man-made systems.
- Diagnosis of man-made objects (underground pipelines, roads, railways, oil and gas facilities).
- Assessment of health and productivity of forests and agricultural crops.
Comprehensive analysis of multispectral space and aircraft data on land and sea is done on the basis of IR and visible imagery, maps of the terrain and bathymetry.

Technology of thermal tomography of the geological environment is based on image processing in the thermal infrared range 8-14 microns. This allows to calculate the effective density of the flux of thermal radiation and block-fault structures at a given depth, the spatial and temporal dynamics of the normalized index of "stress" of vegetation in relation to the deep structure of the geological environment.
On the basis of the developed algorithms and the effective flux density of thermal radiation at a predetermined depth is calculated on the thermal field of the Earth surface. Interpretation of the calculation results leads to formation of a 3-D environment model.

Geothermal signatures detected in the section can be shaped into real environment models, as rock temperature conditions (below the neutral layer) are determined by the upward endogenous heat flow, dynamics of the geological environment and rock thermal characteristics.

Technology of interpretation of Earth thermal field sections and schemes is aimed at selective representation of:
- geodynamical blocks and faults;
- internal thermo-dynamical inhomogeneities;
- rock compression, extension and decompactification zones, which include fluid cross-flow and accumulation areas.

**Section of block-fault structures**

**Thermal field section**
Altitude-varied aircraft-based thermal sensing

**Gas-filled airship**

**Sensing specifications**
- Altitude $H$ from 0.02 to 3 km
- Swath $Ly$ from 0.01 to 2.3 km
- Resolution $\Delta$ from 0.01 to 3.6 m
- Depth $hz$ from 1.2 to 900 m

**The advantages of thermal airship**
- Economy.
- Low cost of operation.
- Transportability.
- Ease of piloting.
- Ability to take off and land in different conditions.
- Working in low-speed (up to hovering).
- Work at extremely low altitudes.
- Environmentally friendly.
- High safety of flight.
Condition monitoring of main pipelines
A new technology for rapid assessment of technical condition of main oil and gas pipelines as well as geo-ecological monitoring has been developed.

With the high-resolution thermal imaging aviation complex one can detect the location of oil spills and gas leaks, illegal pipeline taps, potentially hazardous tectonic zones.

Use of hot-air airship for monitoring the technical condition of main pipelines can significantly increase the information value of diagnosis and reduce costs.
Areas of surface accumulation of oil (spills) appear as anomalous hot areas assuming an irregular shape and covering a large area. In converting the field to a depth value, weakening of thermal anomalies is observed.

Flooding zones take diverse shapes on the plan depending on the geodynamics of their development. Elongated linear zone indicates the direction of fluid migration, and the spherical zone indicates the area of concentration for flooding in the geological environment.
Search for oil and gas deposits both onshore and on sea shelf
The method of Earth remote sensing provides rapid low-cost study of large areas in different settings at the exploratory stage of geological exploration and allows to:

- study the tectonic areas and provide geological zoning of the area highlighting oil and gas accumulation zones;
- map the most promising areas of oil and gas traps, in which it is first of all necessary to conduct seismic surveys;
- significantly reduce the time and cost of geological exploration.
A number of criteria have been worked out for the selection of prospective areas in the search for oil and gas:

- the structure of regional and local thermal fields;
- change in the intensity of the cold local areas;
- the features of deep structures formation and characteristics of the block-fault tectonics.
Thermal tomography of the Black Sea shelf

Based on the spectral survey and developed technology, geo-information products have been obtained for the first time, descriptive of features of 3-D crustal structure of the sea shelf. The method has several advantages and can be widely used by oil companies at various stages of exploration, which allows to receive economic benefits and significantly increase the information value of complex geophysical research of license blocks of the sea shelf.
The results of processing of space thermal images show that the observed local anomalies of 2,5D geothermal field and the location of the contours of established deposits match. Discharges to the north-eastern trending resulted in the formation of high-amplitude horst structure oilfield called «White Tiger». It is in fractured and fault structures of the granitoid basement that the main oil and gas complex can be found, which gives over 90% of total production within Cuu Long depression.
Searching for underground mineral waters and hydrothermal springs

- Search for unloading zones of submarine fresh water through the seafloor in the marine area
- Determining areas of the sea intrusion (penetration of marine water into the continent and its getting into the aquifers)
- The study of hydrothermal deposits and underground mineral water

Remote sensing technology allows to:
- check the quality of underground water traps;
- determine the presence of faults by tracing the unloading zones of deep waters, their impact on the safety of deposits;
- identify areas of fluid accumulation and areas of increased permeability based on developed geothermal criteria.

Model of block-fault structures on the continent and sea shelf (Spain)

Synthesized section of block-fault structures and thermal sources (Karlový Vary, Czech Republic)
The study of impact craters
Tomography of the geological environment allows to locate impact events, to evaluate the possibility of formation of oil, gas and water deposits within the crater formed as a result of shock metamorphism of rocks at the fall of cosmic bodies (meteorites). Payable oil and gas reserves have been discovered in astroblemes of Canada, Mexico and the United States.

The structure of the endogenous heat flow is associated with the shape of the crater and meteorite impact force on the geological environment. The geometry of the crater is outlined by listric faults (zones of low heat flow), the distribution of which depends on the size of the crater. Under the craters a layer of low temperature was discovered, the nature of its formation is associated with decompression of the geological environment saturated with deep seated fluids (water, gas, oil).
Ecological survey of oil and gas fields

3-D model of block-fault structures combined with a $\Delta ISN$ map of the dynamics of the natural environment according to «Landsat»

$\Delta ISN$ map of the dynamics of the natural environment for multi-temporal space satellite imagery «Landsat»

- The most probable path of hydrocarbon migration and deep waters in fault zones up to the surface is determined.
- In areas of high correlation of the anomalous $ISN$ stress index of vegetation and expected outputs of hydrocarbons, extending from producing depth up to the surface, zones of ecological disturbances of the natural environment due to human impact are identified.
WHAT DO WE OFFER?

✓ Geophysical Services: geologic survey, oil and gas prospect evaluation of license blocks onshore and offshore, study of groundwater, monitoring of natural gas storage, environmental survey.

✓ Performance time - 3 months.

✓ Cost of work to be agreed on.

YOUR BENEFIT

✓ Guaranteed result.

✓ Saving time for license block information collection.

✓ Reduced costs for geological exploration (waiver of time-consuming and expensive field work).

✓ Brief but useful information before tender start.
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